Lloyd's Register

Rules and Regulations for the Classification of Ships, July 2010

Notice No. 5

Effective Date of Latest Amendments:

See page 1

Issue date: February 2011

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RULES AND REGULATIONS FOR THE CLASSIFICATION OF SHIPS, *July 2010*

Notice No. 5

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Ships, July 2010.* The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
1	2	2	1 July 2011
3	1	8	1 July 2011
3	10	5	1 July 2011
3	14	1, 8	1 July 2011
3	14	5	Corrigendum
4	1	1, 6, 8, 9	1 July 2011
4	7	3, 8	1 July 2011
4	11	1, 3, 4, 5, 6, 7, 8, 12	1 July 2011
5	13	2	1 July 2011
8	2	1, 2, 3, 6	1 July 2011

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of Ships, July 2010* are to be read in conjunction with this Notice No. 5. The status of the Rules is now:

Rules for Ships	Effective date:	July 2010
Notice No. 1	Effective date:	1 October 2010 & Corrigenda
Notice No. 2	Effective date:	1 January 2011 & Corrigendum
Notice No. 3	Effective date:	1 January 2011 & Corrigenda
Notice No. 4	Effective date	1 February 2011
Notice No. 5	Effective date:	1 July 2011 & Corrigenda

Part 1, Chapter 2

Classification Regulations

Effective date 1 July 2011

■ *Section 2*

Character of classification and class notations

2.3 Class notations (hull)

2.3.16 **ShipRight notations**. The following notations are associated with LR's ShipRight procedures and may be assigned in conjunction with the **ShipRight** notation as considered appropriate by the Classification Committee, on application from the Owners. The requirements pertaining to these notations and the (hull) ShipRight procedures are given in Pt 3, Ch 16.

ShipRight ACS(B,D) This notation (Anti-Corrosion System) will be assigned when coating specification, application and inspection for water ballast tanks (denoted by B) or/and double-side skin spaces (denoted by D) have been verified according to ShipRight procedures.

ShipRight SDA This notation (Structural Design Assessment) will be assigned when direct calculations in accordance with the ShipRight procedures have been applied.

ShipRight FDA This notation (Fatigue Design Assessment) will be assigned when an appraisal has been made of the fatigue performance of the structure in accordance with the ShipRight procedures.

ShipRight FDA plus (*years,WW*) This notation (Fatigue Design Assessment plus) will be assigned when an appraisal has been made for a higher level of fatigue performance than that made for the assignment of **ShipRight FDA**.

ShipRight CM This notation (Construction Monitoring), which complements the **ShipRight SDA, ShipRight FDA** and **ShipRight FDA plus(*years,WW*)** notations, will be assigned when the controls in construction tolerances detailed in the ShipRight procedures have been applied and verified.

2.3.17 When **ShipRight SDA**, **ShipRight FDA** or **ShipRight FDA plus(*years,WW*)** are assigned, the precise technical conditions of the appraisal will be made available to Owners.

2.3.18 Where LR's ShipRight SDA procedure has been applied individually or where ShipRight SDA, ShipRight FDA or ShipRight FDA plus(*years, WW*) and ShipRight CM procedures have all been applied, whether on a voluntary or mandatory basis, these particular class notations will appear in column 4 of the *Register Book*.

Part 3, Chapter 1

General

Effective date 1 July 2011

■ *Section 8*

Inspection, workmanship and testing procedures

8.3 Testing procedures

(*Part only shown*)

Table 1.8.1 Testing requirements

Item to be tested	Testing procedure	Testing requirement
Fuel oil bunkers	Structural, *see* Note 1	
Double plate rudders	~~Structural,~~ ~~*see* Notes 1 & 5~~ Leak	~~2,4 m head of water, and rudder should normally be tested while laid on its side~~

Part 3, Chapter 10

Welding and Structural Details

Effective date 1 July 2011

■ *Section 5* Structural details

5.1 Continuity and alignment

(*Part only shown*)

Table 10.5.1 Total load transmitted to connection of secondary members

Ship type	Head, h_1, in metres	Total load, P, transmitted to connection
(3) Other ship types for which oil tanker (*see* 1.1.3) requirements are not applicable (continued)	Internal tank boundaries	
	(b) Inner bottom and hopper longitudinals (i) For cargo ships and bulk carriers (*see* 1.1.3) without the notation 'strengthened for heavy cargoes' $h_1 = 1{,}39T$ (ii) For cargo ships and bulk carriers (*see* 1.1.3) with the notation 'strengthened for heavy cargoes' $h_1 = H$ (iii) For longitudinal bulkheads of ore carriers $h_1 = H K_\mathrm{c}$	$P = 9{,}81 (S_\mathrm{W} - s_1/2) s_1 h_1/C$ kN $P = (S_\mathrm{W} - s_1/2) s_1 h_1/C$ tonne-f but not to be taken less than the load derived from (b)~~(iii)~~ (iv), (b)~~(iv)~~ (v), (b)~~(v)~~ (vi) or (c) where applicable
	~~(iii)~~ (iv) For bulk carriers (*see* 1.1.3) where the topside wing tank is interconnected with hopper side and double bottom tanks h_1 = the distance from the longitudinal under consideration to the top of the topside tank with the ship inclined 25° either way	$P = 10{,}06 (S_\mathrm{W} - s_1/2) s_1 h_1$ kN ($P = 1{,}025 (S_\mathrm{W} - s_1/2) s_1 h_1$ tonne-f)
	~~(iv)~~ (v) For bulk carriers (*see* 1.1.3) in way of ballast hold h_1 = the distance from the longitudinal under consideration to the top of the hatchway coaming	$P = 10{,}06 (S_\mathrm{W} - s_1/2) s_1 h_1$ kN ($P = 1{,}025 (S_\mathrm{W} - s_1/2) s_1 h_1$ tonne-f)
	~~(v)~~ (vi) For cargo ships and bulk carriers (*see* 1.1.3) with double hull where tank at side interconnected with double bottom $h_1 = H$	$P = 10{,}06 (S_\mathrm{W} - s_1/2) s_1 h_1$ kN ($P = 1{,}025 (S_\mathrm{W} - s_1/2) s_1 h_1$ tonne-f)

B_f = bow fullness factor determined from Fig. 5.4.3 in Chapter 5 to be considered. To be taken as 1 for framing members located at and abaft 0,2L from the forward perpendicular
f = load height factor at level 0,6D above base line, *see* Table 10.5.2
h_1 = load height, in metres, *see also* Fig. 10.5.2
C = stowage rate, in m^3/tonne, as defined in Ch 3,5.2. For cargo ships without the notation 'strengthened for heavy cargoes', the value to be used is 1,39 m^3/tonne. For cargo ships and bulk carriers (*see* 1.1.3) with the notation 'strengthened for heavy cargoes', the actual stowage rate is to be used, but the value is not to be taken greater than 0,865 m^3/tonne
H = height from inner bottom at position under consideration, to deck at side amidships, in metres, for inner bottom longitudinals
= height from the longitudinal under consideration to the underside of the topside tank sloped bulkhead, in metres, for hopper longitudinals
S_W = spacing of primary members, in metres
s_1 = spacing of secondary members, in metres
T = the summer draught, in metres, measured from top of keel
D_2 = D in metres, but need not be taken greater than 1,6T
L_1 = L but need not be taken as greater than 190 m
K_c = as defined in Table 11.7.1 in Pt 4, Ch 11

Part 3, Chapter 14

Cargo Securing Arrangements

Effective date 1 July 2011

■ *Section 1*
General

1.2 Plans and information required

1.2.2 For container securing arrangements, the following plans and information are to be submitted:

(a) General arrangement plan showing the disposition and design weights of the containers.

(b) Details of materials, design, scantlings of cell guides structure, lashing bridges, pedestals, and other container securing arrangements, where fitted.

(c) Details of certification, including safe working load (SWL), of fixed and loose container securing fittings.

(d) Plans of structure in way of fixed container securing fittings and arrangements.

(e) Design values of the following ship parameters for the container load departure and arrival conditions:

Moulded draught (T_c)

Longitudinal centre of flotation (LCF). If this information is not available, for initial design purposes the longitudinal centre of flotation is to be assumed at ~~$0,45L_{pp}$~~ $0,48L_{pp}$ forward of the aft perpendicular.

Transverse metacentric height (GM)

(f) Design wind speed (V_W).

(g) Where available, details of the long term distribution of ship motions, particularly roll, pitch and heave, in irregular seas which the ship will encounter during its operating life. Where simplified dynamic response data, or other means of assessing the maximum motions of the ship, are proposed they are to be submitted for consideration. In other cases the motions defined in Section 8 will be used.

(h) The lashing calculations in the cargo securing manual are to be based on two design GM values. The lower design value is to be taken as 2,5 per cent of the breadth *B*, and the upper design value is to be taken as 7,5 per cent of *B*. In addition to these two design GM values, actual GM values of the ship in the container loaded condition from the approved trim and stability booklet ~~may be included, if available~~ are to be included when the design GM values are outside the above range.

1.4 Symbols and definitions

1.4.1 The following definitions are applicable to this Chapter, except where otherwise stated:

a = breadth of the container, in metres

a_0 = acceleration parameter, taken equal to:

$$a_0 = (1{,}58 - 0{,}47C_b)\left(\frac{2{,}4}{\sqrt{L_{pp}}} + \frac{34}{L_{pp}} - \frac{600}{L_{pp}^2}\right)$$

a_{surge} = longitudinal acceleration due to surge, in m/s^2

$$a_{surge} = 0{,}275a_0\,g$$

a_{sway} = transverse acceleration due to sway, in m/s^2

$$a_{sway} = 0{,}55a_0\,g$$

a_{heave} = vertical acceleration due to heave, in m/s^2

$$a_{heave} = a_0\,g$$

a_{roll} = roll acceleration at the centre of gravity of the vessel, in rad/s^2

$$a_{roll} = 0{,}69\frac{\phi}{T_r^2}$$

a_{pitch} = longitudinal acceleration due to pitch, in rad/s^2

$$a_{pitch} = 0{,}69\left(1 + \frac{0{,}98}{\sqrt{L_{pp}}}\right)\frac{\psi}{T_p^2}$$

b = length of the container, in metres

C_{p1} = hull whipping factor used in LC_1 to be taken from Fig. 14.1.1

e = base of natural logarithms, 2,7183

f_{ap} = hull form coefficient and is to be taken as:

$f_{ap} = 1{,}2R_A^{0{,}3}$ for $R_A > 1{,}0$

$f_{ap} = 1{,}2$ for $R_A <= 1{,}0$

f_{BK} = coefficient taken equal to:

$f_{BK} = 1{,}2$ for ships without bilge keels

$f_{BK} = 1{,}0$ for ships with bilge keels

LC_n = load case n

g = acceleration due to gravity and is to be taken as 9,81 m/s^2

~~x~~ x_1 = longitudinal horizontal distance from O_m to the centre of the container (positive forwards), in metres

~~y~~ y_1 = transverse horizontal distance from the centreline of the ship to the centre of the container (positive to portside), in metres

~~z_m~~ z_1 = vertical distance from O_m to the centre of gravity of the container (positive upwards), in metres

A = ~~projected~~ side area of the container, in m^2

~~B = moulded breadth of the ship, in metres~~

~~D = moulded depth of the ship, in metres~~

GM = transverse metacentric height of the ship

KG = vertical distance of the centre of gravity of the ship, above the keel, in metres

L_{pp} = length between perpendiculars of the ship, in metres

O_m = centre of motion, to be taken on the centreline at the longitudinal centre of flotation of the ship and at a distance $2T_c/3 + KG/3$ above the keel, but not less than the greater of T_c and $D/2$

R = the rating, or maximum operating gross weight for which the container is certified, and is equal to the tare weight plus payload of the container, in tonnes

R_A = area ratio factor for combined stern and bow shape, defined in Pt 4, Ch 2,2.4

T_c = moulded draught in the container load condition, in metres

T_h = full period of heave of the ship, in seconds

T_p = full period of pitch of the ship, in seconds

T_r = full period of roll of the ship, in seconds

V_w = wind speed, in m/s. For ships with an unrestricted worldwide service area notation a wind speed of 40 m/s is to be applied

W = design weight of the container and contents, in tonnes. In general W is to be taken as R unless reduced maximum weights are specified. The following minimum weights W are to be used:

20 ft container	2,5 tonnes
40 ft container	3,5 tonnes
45 ft container	4,0 tonnes
48 ft and 53 ft container	4,5 tonnes

ϕ = maximum single amplitude of roll, in degrees
ψ = maximum single amplitude of pitch, in degrees.

1.4.2 The co-ordinate system used in this Chapter is defined with respect to the right-hand co-ordinate system shown in Fig. 14.1.2, with the origin at the centre of motion.

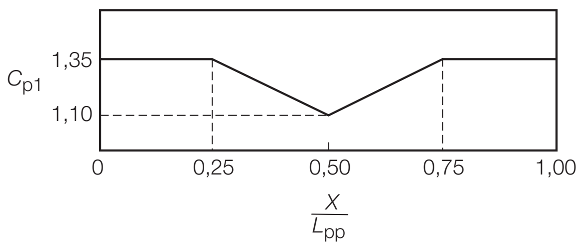


Fig. 14.1.1 The value of C_{p1} along ship length

1.4.3 For ship motions and accelerations defined in this Chapter, the sign convention shown in Fig. 14.1.2 is adopted. The roll, pitch and yaw motions are defined positive clockwise as shown in the figure. For instance, positive sway is defined as the translation toward portside of the vessel and positive pitch as the rotation of the vessel when bow is down and stern is up.

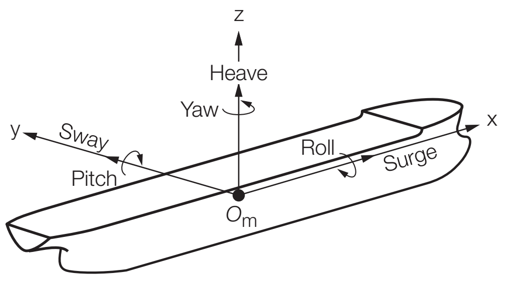


Fig. 14.1.2
Co-ordinate system and sign convention of motions

CORRIGENDUM

Section 5
Container securing arrangements for stowage on exposed decks without cell guides

5.4 Containers in more than two tiers

5.4.8 For stowage arrangements incorporating fully automatic fittings which do not mechanically secure the container in pure vertical direction when subject to vertical motions, it is to be ensured that no separation occurs under the load ~~case~~ cases specified in ~~8.2.3(b)~~ 8.2.3. In addition, where exposed stacks are secured with fully automatic fittings without internal cross lashings, provision is to be made to prevent buoyancy forces acting on the container which could disengage the containers. In this case the use of effective side screens is required. Otherwise, the first tier of containers is to be secured by manual or semi-automatic twistlocks.

Effective date 1 July 2011

Section 8
Determination of forces for container securing arrangements

8.1 General

8.1.2 The following forces are to be taken into account:

- Static gravity forces.
- Inertial forces generated by accelerations due to roll, pitch ~~and~~ heave, surge and sway motions of the ship.
- Wind forces.
- Forces imposed by the securing arrangements.
- Wave impact forces.
- Additional forces due to hull form at the forward and aft ends and due to hull whipping.

8.1.3 ~~Where ship~~ Ship response data ~~is not available the values for roll, pitch and heave as~~ given in 1.4 ~~Table 14.8.1~~ will be used for the calculation of accelerations.

~~**Table 14.8.1 Ship motions**~~

Motion	Maximum single amplitude	Periods, in seconds
Roll	ϕ = $\sin^{-1}\theta$ degrees but need not exceed 30° and is not to be taken less than 22° where $\theta = \sin\phi$ $= \left(0,45 + 0,1\frac{L}{B}\right)\left(0,54 - \frac{L}{1270}\right)$	$T_r = \frac{0,7B}{\sqrt{GM}}$
Pitch	$\psi = 12e^{-0,0033L_{pp}}$ but need not exceed 8°	$T_p = 0,5\sqrt{L_{pp}}$
Heave	$\frac{L_{pp}}{80}$ m	$T_h = 0,5\sqrt{L_{pp}}$

Table 14.8.1 Ship motions

Motion	Maximum single amplitude (degrees)	Periods (seconds)
Roll	$\phi = \dfrac{3979\,(1{,}25 - 0{,}025T_r)\,f_{BK}}{(B + 75)}$ ϕ is not to be taken less than 22° but need not exceed 30°	$T_r = \dfrac{0{,}84B}{\sqrt{GM}}$
Pitch	$\psi = 1350L_{pp}^{-0{,}94}\left(1{,}0 + \left(\dfrac{0{,}82}{\sqrt{L_{pp}}}\right)^{1{,}2}\right)$ ψ = need not exceed 8°	$T_p = 0{,}80\sqrt{C_1L_{pp}}$ where C_1 is generally to be taken as 0,52 For the head sea condition, C_1 should be taken as 0,95

8.1.6 The individual components of force due to gravity, wind and ship motions acting on a particular container are to be determined in accordance with Table 14.8.2 for the specified load cases.

8.1.7 The individual components of acceleration due to ship motions on a container are:

- Sliding (Longitudinal)

$a_x = C_{xS}\,a_{surge} + C_{xP}\,a_{pitch}\,z_1 - C_{xG}\,g\,\sin\psi$

- Sliding (Transverse)

$a_y = C_{yS}\,a_{sway} - C_{yR}\,a_{roll}\,z_1 + C_{yG}\,g\,\sin\phi$

- Compression (Vertical)

$a_z = C_{p1}\,(C_{zH}\,a_{heave} + C_{zR}\,a_{roll}\,y_1 - C_{zP}\,a_{pitch}\,x_1)$

Load combination factors C_{xS}, C_{xP}, C_{xG}, C_{yS}, C_{yR}, C_{yG}, C_{zH}, C_{zR} and C_{zP} for each load case are given in Tables 14.8.3 and 14.8.4.

C_{p1} for LC1 is given in Fig. 14.1.1. For other load cases the value of C_{p1} is to be taken as 1,0.

Existing paragraphs 8.1.7 *to* 8.1.9 *have been renumbered* 8.1.8 *to* 8.1.10.

~~**Table 14.8.2 Components of forces**~~

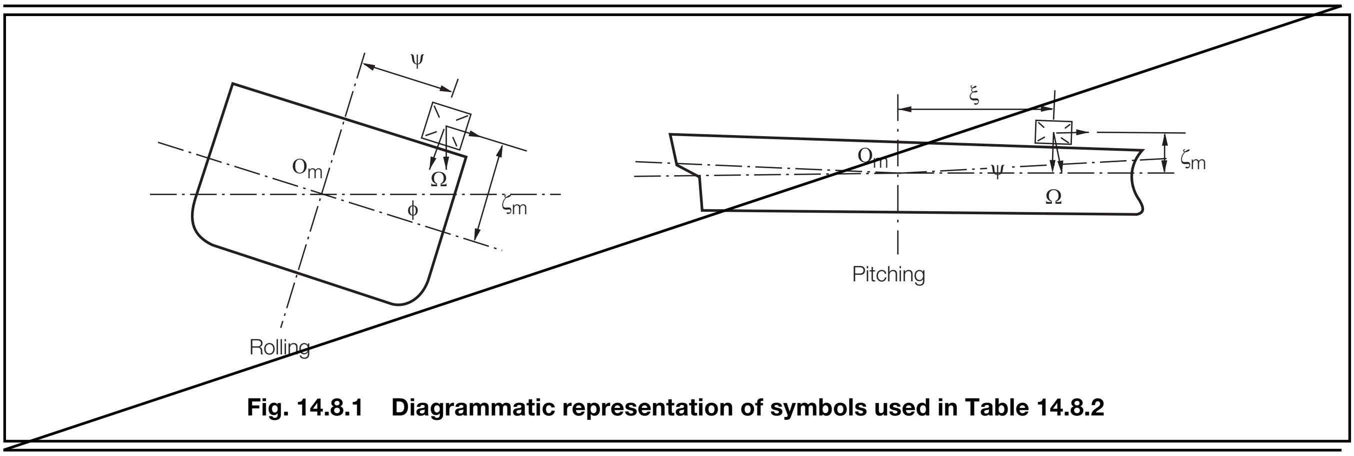
Source	Component of force, in kN		
	Compression (normal to deck)	Sliding (parallel to deck)	
		transverse	longitudinal
STATIC			
Roll	$Wg\cos\phi$	$Wg\sin\phi$	
Pitch	$Wg\cos\psi$		$Wg\sin\psi$
Combined	$Wg\cos(0{,}71\phi)\cos(0{,}71\psi)$	$Wg\sin(0{,}71\phi)$	$Wg\sin(0{,}71\psi)$
DYNAMIC			
Roll	$0{,}07Wg\,\dfrac{\phi}{T_r^2}\,y$	$0{,}07Wg\,\dfrac{\phi}{T_r^2}\,z_m$	
Pitch	$0{,}07Wg\,\dfrac{\psi}{T_p^2}\,x$		$0{,}07Wg\,\dfrac{\psi}{T_p^2}\,z_m$
Heave:			
Roll	$0{,}05Wg\,\dfrac{L_{pp}}{T_h^2}\,\cos\phi$	$0{,}05Wg\,\dfrac{L_{pp}}{T_h^2}\,\sin\phi$	
Pitch	$0{,}05Wg\,\dfrac{L_{pp}}{T_h^2}\,\cos\psi$		$0{,}05Wg\,\dfrac{L_{pp}}{T_h^2}\,\sin\psi$
WIND		Roll $8{,}25AV_W^2\cos^2\phi \times 10^{-4}$ Pitch $8{,}25AV_W^2 \times 10^{-4}$ Combined $8{,}25AV_W^2\cos^2(0{,}71\phi) \times 10^{-4}$	

NOTES
1. For definition of terms, *see* 1.4.1 and Fig. 14.8.1.
2. The appropriate signs are to be used in calculating vector components of forces.

Table 14.8.2 Components of forces

Load case	Components of forces, in kN				
	Ship motion induced force			Wind and gravity forces	
	Sliding, J_{DY} (longitudinal, parallel to deck)	Sliding H_{DY} (transverse, parallel to deck)	Compression, P_{DY} (normal to deck)	Wind, Q (transverse, parallel to deck)	Compression, P_{GW} (normal to deck)
LC1	Wa_x	Wa_y	Wa_z	$2{,}75A\ V_w^2 \times 10^{-4}$	$Wg \cos \psi$
LC2	Wa_x	Wa_y	Wa_z	$8{,}25A\ V_w^2 \cos^2 \phi \times 10^{-4}$	$Wg \cos \phi$
LC3	Wa_x	Wa_y	Wa_z	$7{,}18A\ V_w^2 \times 10^{-4}$	$Wg \cos \psi$
LC4	Wa_x	Wa_y	Wa_z	$4{,}13A\ V_w^2 \cos^2 \phi \times 10^{-4}$	$Wg \cos \phi$
LC5	Wa_x	Wa_y	Wa_z	$8{,}00A\ V_w^2 \times 10^{-4}$	$Wg \cos \psi$

NOTES
1. For definition of terms, *see* 1.4.1 and Fig. 14.8.1.
2. For definition of load cases, *see* 8.2.3.
3. For definition of a_x, a_y and a_z, *see* 8.1.7.
4. The forces caused by heeling of a ship in port are to be specially considered.
5. The appropriate signs are to be used in calculating components of forces.



~~**Fig. 14.8.1 Diagrammatic representation of symbols used in Table 14.8.2**~~

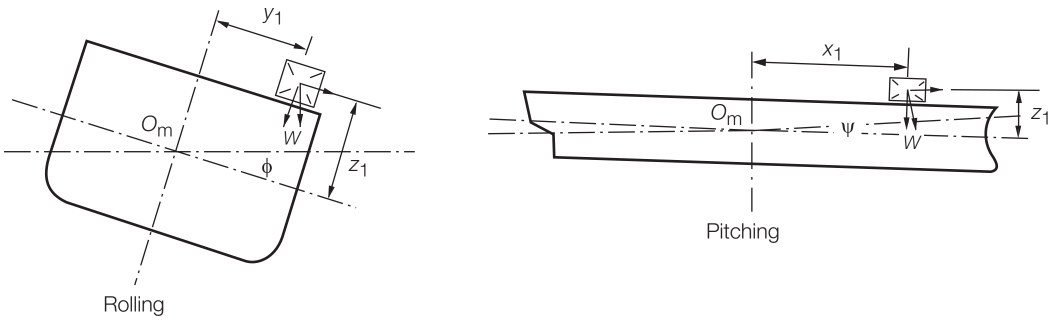


Fig. 14.8.1 Diagrammatic representation of symbols used in Table 14.8.2

8.2 Resultant forces

8.2.1 The resultant force acting on the container is the vectorial summation of the individual directional components of all forces acting at a given instant~~, see Fig. 14.8.2~~. The securing system is to be designed on the basis of the most severe combination of these forces in such a manner that the forces on the containers and securing devices are within allowable limits. Where different arrangements of securing devices are proposed for different locations on the ship, the forces are to be calculated for the most severe condition applicable to each arrangement.

~~*8.2.2* The instantaneous maximum value of the resultants of the forces depends upon the phase relationship between the ship motions. This relationship may be derived from model testing where carried out for the specific ship, from ship motion analysis or from full scale measurements if carried out for a ship of similar geometry.~~

8.2.2 The resultants in each of the three co-ordinate axes defined in Fig. 14.1.2 are to be derived from the individual components of force determined from Table 14.8.2 for the load cases given in 8.2.3.

~~*8.2.3* Alternatively, the resultants in each of the three co-ordinate axes may be derived from the individual components of force determined from Table 14.8.2 for the instantaneous positions in the motion cycle as follows:~~

~~(a) Rolling condition:~~
  ~~(i) Maximum roll (descending) with maximum heave (descending).~~
  ~~(ii) Maximum roll (ascending) with maximum heave (ascending).~~
~~(b) Pitching condition:~~
  ~~(i) Maximum pitch (descending) with maximum heave (descending).~~
  ~~(ii) Maximum pitch (ascending) with maximum heave (ascending).~~
~~(c) Combined condition:~~
  ~~(i) 0,71 [Maximum roll (descending) with maximum pitch (descending)].~~
  ~~(ii) 0,71 [Maximum roll (ascending) with maximum pitch (ascending)].~~

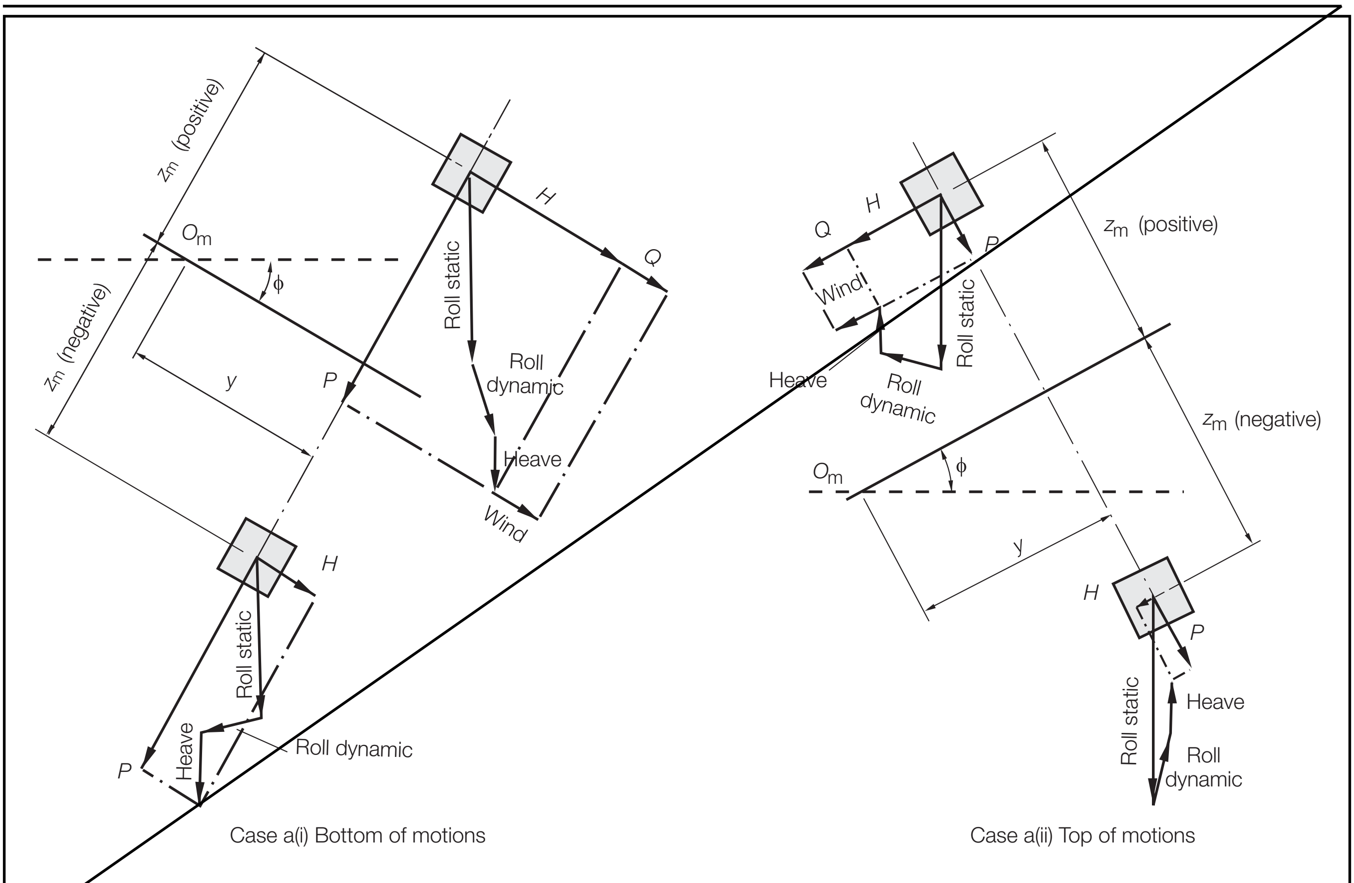


Fig. 14.8.2 Components of force on one container (Rolling condition)

8.2.3 The Load Combination Factors (LCFs) given in Tables 14.8.3 and 14.8.4 are to be used, in which regular waves that generate response values equivalent to the long-term response values of the load components considered are set as Equivalent Design Waves (EDWs). The following five sets of load cases (LCs) are to be considered:

LC1:
in a head sea when the vertical acceleration becomes maximum;

LC2:
in a beam sea when the roll motion becomes maximum;

LC3:
when the pitch acceleration becomes maximum in an oblique sea;

LC4:
when the roll motion becomes maximum in an oblique sea with forward speed;

LC5:
combined condition of transverse and vertical accelerations in an oblique sea.

~~*8.2.4* The summation of the individual components of force for one container above or below the centre of motion is shown for the Rolling condition in Fig. 14.8.2, and the resultants are obtained from the following expressions:~~

~~(a) Bottom of motions, *see* 8.2.3 (a)(i):~~
~~Compression~~

~~$P_{max} = Wg\left[\left(1 + \frac{0{,}05L_{pp}}{T_h^2}\right)\cos\phi + \frac{0{,}07\phi}{T_r^2}\,y\right]$~~

~~Sliding (transverse)~~

~~$H_{max} = Wg\left[\left(1 + \frac{0{,}05L_{pp}}{T_h^2}\right)\sin\phi + \frac{0{,}07\phi}{T_r^2}\,z_m\right]$~~

~~(b) Top of motions, *see* 8.2.3(a)(ii):~~
~~Compression~~

~~$P_{min} = Wg\left[\left(1 - \frac{0{,}05L_{pp}}{T_h^2}\right)\cos\phi - \frac{0{,}07\phi}{T_r^2}\,y\right]$~~

~~Sliding (transverse)~~

~~$H_{min} = Wg\left[\left(1 - \frac{0{,}05L_{pp}}{T_h^2}\right)\sin\phi + \frac{0{,}07\phi}{T_r^2}\,z_m\right]$~~

~~The corresponding summations for the Pitching and Combined conditions may be written similarly.~~

8.2.4 The summation of the individual components of force for each container is obtained to give the following resultants:

- Sliding (Longitudinal)
  $J = J_{DY}$
- Sliding (Transverse)
  $H = H_{DY}$
- Compression (Vertical)
  $P = P_{DY} + P_{GW}$

J_{DY}, H_{DY}, P_{DY}, H_{GW} and P_{GW} are to be calculated in accordance with Table 14.8.2. The maximum and minimum values of force are determined from the calculated resultants.

Table 14.8.3 Load combination factors (LCFs) for head sea and beam sea cases

Load case			LC1		LC2			
Heading			Head		Beam			
Incoming wave			From bow		From port side		From starboard side	
		LCF	HS_1	HS_2	BS_1P	BS_2P	BS_1S	BS_2S
Longitudinal accelerations	a_{surge}	C_{xS}	–0,69	0,69	0	0	0	0
	a_{pitch}	C_{xP}	f_{ap}	$-f_{ap}$	0	0	0	0
	$g\sin\psi$	C_{xG}	–0,85	0,85	0	0	0	0
Transverse accelerations	a_{sway}	C_{yS}	0	0	–0,09	0,09	0,09	–0,09
	a_{roll}	C_{yR}	0	0	0,66	–0,66	–0,66	0,66
	$g\sin\phi$	C_{yG}	0	0	–0,66	0,66	0,66	–0,66
Vertical accelerations	a_{heave}	C_{zH}	–0,18	0,18	0,14	–0,14	0,14	–0,14
	a_{roll}	C_{zR}	0	0	0,66	–0,66	–0,66	0,66
	a_{pitch}	C_{zP}	f_{ap}	$-f_{ap}$	0	0	0	0

Table 14.8.4 Load combination factors (LCFs) for oblique cases

Load case			LC3				LC4				LC5			
Incoming wave			From port side		From starboard side		From port side		From starboard side		From port side		From starboard side	
		LCF	OS1_1P	OS1_2P	OS1_1S	OS1_2S	OS2_1P	OS2_2P	OS2_1S	OS2_2P	OS3_1P	OS3_2P	OS3_1S	OS3_2S
Londitudinal accelerations	a_{surge}	C_{xS}	–0,43	0,43	–0,43	0,43	0	0	0	0	0,62	–0,62	0,62	–0,62
	a_{pitch}	C_{xP}	1,0	–1,0	1,0	–1,0	0	0	0	0	–0,46	0,46	–0,46	0,46
	$g \sin\psi$	C_{xG}	–0,86	0,86	–0,86	0,86	0	0	0	0	0,65	–0,65	0,65	–0,65
Transverse accelerations	a_{sway}	C_{yS}	–0,28	0,28	0,28	–0,28	0	0	0	0	0,96	–0,96	–0,96	0,96
	a_{roll}	C_{yR}	–0.22	0,22	0,22	–0,22	1,0	–1,0	–1,0	1,0	–0,36	0,36	0,36	–0,36
	$g \sin\phi$	C_{yG}	0,05	–0,05	–0,05	0,05	–1,0	1,0	1,0	–1,0	0,12	–0,12	–0,12	0,12
Vertical accelerations	a_{heave}	C_{zH}	–0,29	0,29	–0,29	0,29	0	0	0	0	0,11	–0,11	0,11	–0,11
	a_{roll}	C_{zR}	0,05	–0,05	–0,05	0,05	0	0	0	0	–0,36	0,36	0,36	–0,36
	a_{pitch}	C_{zP}	1,0	–1,0	1,0	–1,0	0	0	0	0	–0,46	0,46	–0,46	0,46

Part 4, Chapter 1

General Cargo Ships

Effective date 1 July 2011

■ *Section 1*
General

1.5 Symbols and definitions

1.5.1 The following symbols and definitions are applicable to this Chapter unless otherwise stated:

L, *B*, *D*, *T* and *V* as defined in Pt 3, Ch 1,6

k_L,k = higher tensile steel factor, *see* Pt 3, Ch 2,1

e = base of natural logarithms, 2,7183

l = overall length of stiffening member, or pillar, in metres, *see* Pt 3, Ch 3,3

l_e = effective length of stiffening member, or pillar, in metres, *see* Pt 3, Ch 3,3

t = thickness of plating, in mm

s = spacing of secondary stiffeners, in mm

A = cross-sectional area of stiffening member, in cm^2

C = stowage rate, in m^3/tonne, *see* Pt 3, Ch 3,5

C_w = a wave head in metres
= $7{,}71 \times 10^{-2}\, L e^{-0{,}0044L}$ where *L* is not to be taken greater than 227

I = inertia of stiffening member, in cm^4, *see* Pt 3, Ch 3,3

S = spacing or mean spacing of primary members, in metres

Z = section modulus of stiffening member, in cm^3, *see* Pt 3, Ch 3,3

ρ = relative density (specific gravity) of liquid carried in a tank but is not to be taken less than 1,025.

■ *Section 6*
Shell envelope framing

6.2 Longitudinal stiffening

6.2.1 For non-**CSR** tankers, ~~and~~ bulk carriers and ore carriers (*see* Pt 1, Ch 2,2.3) the scantlings of bottom and side longitudinals in the midship region are to comply with the requirements given in Table 1.6.1(b). In general other ships are to comply with Table 1.6.1(a).

■ *Section 8*
Double bottom structure

8.3 Girders

~~*8.3.1* For tankers the centre girder is to have a depth of not less than that given by:~~

~~d_{DB} = $28B + 205\sqrt{T}$ mm~~

~~nor less than 650 mm. The centre girder thickness is to be not less than:~~

~~t = $(0{,}008 d_{DB} + 4)\sqrt{k}$ mm~~

~~nor less than 6,0 mm. The thickness may be determined using the value for d_{DB} without applying the minimum depth of 650 mm.~~

~~*8.3.2*~~ *8.3.1* ~~For cargo ships and passenger ships other than tankers the~~ The minimum depth of the centre girder is to be taken as the greater of the following:

(a) $d_{DB} = 28B + 205\sqrt{T}$ mm

(b) $d_{DB} = 50B$ mm, but need not be taken as greater than 2000 mm

(c) $d_{DB} = 760$ mm.

8.3.2 The centre girder thickness is to be not less than:

$$t = (0{,}008d_{DB} + 4)\sqrt{k} \quad \text{mm}$$

nor less than 6,0 mm. The thickness may be determined using the value for d_{DB} without applying the minimum ~~depth of 760 mm~~ depths specified in 8.3.1(b) and (c).

■ *Section 9*
Bulkheads

9.2 Watertight and deep tank bulkheads

(*Part only shown*)

Table 1.9.1 Watertight and deep tank bulkhead scantlings

Item and requirement	Watertight bulkheads	Deep tank bulkheads
(1) Plating thickness for plane, symmetrically corrugated and double plate bulkheads	$t = 0{,}004s\,f\sqrt{h_4 k}$ mm but not less than 5,5 mm	$t = 0{,}004s\,f\sqrt{\dfrac{\rho h_4 k}{1{,}025}} + \cancel{K_1}\ 2{,}5$ mm but not less than 6,5 mm, where $L <$ 90 m nor less than 7,5 mm, where $L \geq$ 90 m
Symbols ~~K_1 = 3,5 mm within 3 m below top of bulkhead~~ ~~= 2,5 mm elsewhere~~		

Part 4, Chapter 7
Bulk Carriers

Effective date 1 July 2011

■ *Section 3*
Longitudinal strength

3.1 General

3.1.1 Longitudinal strength calculations are to be made in accordance with the requirements given in Pt 3, Ch 4 and 1.5.6 and 1.5.7 where appropriate.

3.1.2 Longitudinal strength calculations for the flooded conditions defined in 3.2 to 3.4 are to be applied for bulk carriers which satisfy all of the following criteria:

- Single skin construction, or double skin construction where any part of the longitudinal bulkhead is located within B/5 or 11,5 m, whichever is less, inboard from the ship's side at right angles to the centreline at the assigned summer load line.
- Length, *L*, of 150 m or above.
- Intended for the carriage of cargoes having bulk densities of 1,0 tonne/m^3 or above.

■ *Section 8*
Double bottom structure

8.1 General

8.1.4 The requirements given in 8.8 are to be applied to bulk carriers which satisfy the following criteria:

- Single skin construction, or double skin construction where any part of the longitudinal bulkhead is located within B/5 or 11,5 m, whichever is less, inboard from the ship's side at right angles to the centreline at the assigned summer load line.
- Length, *L*, of 150 m or above.
- Intended for the carriage of cargoes having bulk densities of 1,0 tonne/m^3 or above.

Part 4, Chapter 11

Ore Carriers

Effective date 1 July 2011

■ *Section 1*
General

1.1 Application

1.1.3 The scantlings of structural items may be determined by direct calculation. Where the length of the ship exceeds 150 m, the scantlings of the primary supporting structure are to be assessed by direct calculation and the application of ShipRight notations SDA and CM are mandatory. ~~certain scantlings will be required to be assessed by direct calculation~~. In such cases, the calculations are to be submitted for approval.

1.1.5 Ore carriers with a deadweight greater than 200 000 tonnes are to comply with the requirements of Section 12 for single pass loading.

■ *Section 3*
Longitudinal strength

3.1 General

3.1.2 For ships of length ≥150 m, with holds where any part of the longitudinal bulkhead is located within B/5 or 11,5 m, whichever is less, inboard from the ship's side at right angles to the centreline at the assigned summer load line, the requirements of Ch 7,3 are also to be applied.

■ *Section 4*
Hull envelope plating

4.4 Hatch coamings

4.4.2 Wire rope grooving in way of cargo hold openings is to be prevented by fitting suitable protection, such as half-round bars, on the hatch side girders (upper portion of top-side tank plates), hatch end beams, and the upper portion of hatch coamings.

■ *Section 5*
Hull framing

5.1 General

5.1.2 Lateral buckling of longitudinal and transverse ordinary stiffeners is to be assessed in the following areas in association with a factor of safety of not less than 1,15 (allowable utilisation factor to be reduced by at least 1/1,15 = 0,87). Details are to be submitted:
- hatchway coaming;
- inner bottom;
- sloped stiffened panel of topside tanks (if any);
- longitudinal bulkhead;
- top stool and bottom stool of transverse bulkhead (if any) and
- stiffened transverse bulkhead (if any).

5.3 Bottom longitudinals in double bottom tanks

5.3.1 The section modulus of bottom longitudinals in the double bottom in the centre hold is to satisfy the requirements of Table 1.6.1(b) in Chapter 1.

■ *Section 6*
Double bottom construction

6.1 General

6.1.1 The double bottom depth and scantlings are to be as required by Ch 7,8 for the double bottom structure of a bulk carrier to which the notation 'strengthened for heavy cargoes' is to be assigned. However, where 3.1.2 is not applicable, the requirements of Ch 7,8.8 need not be applied. The required depth of double bottom and scantlings of double bottom structure are~~, however,~~ to be verified by direct calculation. The calculation is to be submitted.

6.1.3 The thickness of inner bottom plating in the cargo hold is to be not less than required by Ch 7,8 for ships having the notation 'strengthened for heavy cargoes'. ~~The requirements of Ch 7,8.1 relating to discharge by grabs are to be applied.~~

6.1.4 For all vessels intended to be unloaded by grabs, the thickness of inner bottom plating is to meet the requirements of Pt 3, Ch 9,9.2.1(a) for a maximum design grab weight specified and recorded in the Loading Manual. For vessels of deadweight >200 000 tonnes, the design grab weight is not to be less than 25 tonnes.

6.1.5 Where the requirements of 6.1.4 are met the descriptive note '**holds suitable for unloading by grabs**' may be employed. Where the design grab weight is 25 tonnes or more the notation '**strengthened for regular discharge by heavy grabs**' may be assigned.

■ *Section 7*
Longitudinal bulkheads

7.1 General

7.1.2 Longitudinal bulkhead scantlings are to be additionally assessed against ore loading in accordance with Table 11.7.1.

Existing paragraphs 7.1.2 *to* 7.1.4 *have been renumbered* 7.1.3 *to* 7.1.5.

7.1.6 Where inner bottom plating is increased as required by 6.1.4, the lower part of the longitudinal bulkhead should also be increased in accordance with Pt 3, Ch 9,9.2.1, for a minimum of 1,5 m above the line of the inner bottom, based on the actual spacing of stiffeners.

■ *Section 8*
Transverse bulkheads

8.3 Transverse watertight bulkheads in centre holds

8.3.1 Scantlings are to comply with Pt 4, Ch 1,9 and assessed against ore loading in accordance with Table 11.7.1. Transverse corrugated bulkhead scantlings may be determined by direct calculations but are not to be less than required by the watertight bulkhead requirements of Pt 4, Ch 1,9.

~~8.3.1~~ 8.3.2 ~~The~~ For ships where the requirements of 3.1.2 are applicable, the requirements for transverse hold bulkheads given for the carriage of dry bulk cargoes in Ch 7,10 are also to be applied.

~~8.3.2~~ 8.3.3 In general, the bulkheads are to have stiffening or corrugations arranged vertically, supported by top and bottom end stools. Alternative arrangements will, however, be considered.

8.3.4 Where inner bottom plating is increased as required by 6.1.4, the lower part of the transverse bulkhead should also be increased in accordance with Pt 3, Ch 9,9.4.1.

■ *Section 12*
Single pass loading

12.1 Scope and application

12.1.1 The requirements of this Section are to be applied to all ore carriers with a deadweight greater than 200 000 tonnes. The requirements are for single pass loading where the maximum permissible cargo intake per cargo hold may be loaded in a single loading pour.

Table 11.7.1 Longitudinal and transverse bulkhead scantlings for ore loading

Item	Longitudinal and transverse bulkhead
Plate thickness including corrugations (mm)	$t = 0{,}004 s f \sqrt{\dfrac{K_c H k}{C}} + 3{,}5$ mm
Modulus of rolled and built stiffeners, and symmetrical corrugations (cm^3)	$Z = \dfrac{s k K_c H l_e^2}{22C \gamma (\omega_1 + \omega_2 + 2)}$ cm^3

Symbols

s, S, k, l as defined in Ch 1,1.5.1

f = 1,1 – s/2500S but not to be taken greater than 1,0

l_e = effective length of stiffening member, in metres, and for bulkhead stiffeners, to be taken as $l - e_1 - e_2$

γ = 1,4 for rolled or built sections and double plate bulkheads

= 1,6 for flat bars

= 1,1 for symmetrical corrugations of deep tank bulkheads

= 1,0 for symmetrical corrugations of watertight bulkheads

ω, e = as defined in Table 1.9.3 in Chapter 1, *see also* Fig. 1.9.1. Where applicable the value of M_2 is to be taken as

$$= \frac{K_c H s l^2}{22C}$$

K_c = ore pressure coefficient, to be taken as $\cos^2 \alpha + (1 - \sin\psi) \sin^2 \alpha$ for inner side (hopper tank, transverse and longitudinal bulkheads, lower stool, vertical upper stool, etc.), and where:

K_c = 0 for top side tank, upper deck and sloped upper stool

α = angle, in degrees, between panel considered and the horizontal plane

ψ = assumed angle of repose, in degrees, of bulk cargo (considered drained and removed); in the absence of more precise evaluation to be taken as ψ = 35° for iron ore

H = height, from position under consideration to deck at side amidships, in metres

C = stowage rate, in m^3/tonne, as defined in Pt 3, Ch 3,5.2. For vessels where 1.1.5 is applicable, C is to include the cargo overshoot specified in 12.4.1(e)

12.2 Information required

12.2.1 In addition to the plans required for submission by Pt 3, Ch 1,5.2 and as detailed in the applicable Chapters, the following information is also to be submitted:

(a) Maximum permissible cargo in each cargo hold.
(b) Cargo mass curves for a single and adjacent hold loadings taking into account the cargo overshoot defined in 12.4.1(e).
(c) One or more cargo loading sequences intended for single pass loading, *see* 12.2.2.
(d) Details of ballast and deballast piping arrangements and pumping capacity.
(e) Specification of loading computer.

12.2.2 The cargo loading sequences as required by 12.2.1(c) are to include the following:

(a) Start and end times of each cargo pour and the intended loading rate.
(b) Start and end times of each deballasting operation and the intended discharge rate.
(c) Intermediate points (in time) during pours and between pours. In general, the interval between intermediate points is not to be greater than 1 hour.
(d) The ship's loading condition, including the ship's draughts at the fore and aft perpendiculars, amount of cargo in each hold and amount of ballast in each tank, and the still water bending moments and shear forces, are to be provided for each point (in time) of the loading operation specified in (a), (b) and (c).

12.3 Definitions

12.3.1 **Pour**. A pour is defined by the start and finish of loading of a cargo hold. A pour finishes when the loading equipment changes position to a new cargo hold.

12.3.2 **Overshooting**. Overshooting is to be taken as the consequence of mistiming the loading of cargo, resulting in cargo overloading.

12.4 Cargo loading conditions for design assessment

12.4.1 For the purpose of the design assessment, the following conditions are assumed:

(a) Cargo loading and deballasting operations are co-ordinated, with the deballast capacity and arrangement of the vessel designed to accommodate the specified loading sequences.
(b) The cargo is distributed symmetrically in a hold space.
(c) Deballasting is carried out for each pair of symmetrical port and starboard tanks simultaneously, so that each pair of symmetrical port and starboard ballast tanks contain equal amounts of water ballast throughout deballasting operations.
(d) To improve deballasting and stripping, the trim of the ship is to be, in general, by the stern throughout the cargo loading operation.
(e) A cargo overshoot per cargo hold is taken as 10 per cent of the maximum permissible hold cargo mass or 3000 tonnes, whichever is the lesser, but not less than 5 per cent of the maximum permissible hold cargo weight, in any case. A higher cargo overshoot may be specially considered.
(f) Loading more than one cargo hold simultaneously in a single pass, i.e. simultaneous filling of two or more holds, will be specially considered. The specific loading conditions are to be submitted for appraisal in addition to the condition(s) for standard single-pass loading.

12.5 Design assessment

12.5.1 The following criteria are to be complied with in all cargo loading sequences:

(a) Still water bending moment and shear force are within the allowable limits.
(b) Single hold loading is within the allowable hold mass curve.
(c) Two adjacent holds loading are within the allowable hold mass curve.

12.5.2 Arrangements and scantlings of local stiffeners and plating within the cargo hold region are to comply with Sections 1 to 11 with consideration of the maximum permissible cargo mass per hold in the loading manual and the cargo overshoot specified in 12.4.1(e).

12.5.3 The primary structure and plating within the cargo hold region are to be assessed in accordance with the *ShipRight SDA Procedure for Ore Carriers*.

12.6 Ballast arrangements

12.6.1 The deballasting capacity of the vessel, including arrangement of ballast tanks, pumps and relevant piping system, are to be sufficient for the loading operations as agreed in the approved loading plan.

12.6.2 A smaller diameter stripping system with separate main and branch lines may need to be provided in order to achieve the required deballasting capacity.

12.7 Loading manual

12.7.1 All loading sequences of single pass loading, maximum loading rates and ballast pumping details are to be submitted for approval and included in the Loading Manual. Loading conditions at intermediate points as described in 12.2.2(c) need not be included in the Loading Manual.

12.8 Loading computer

12.8.1 The ship is to be installed with sensors for remote measurement of water ballast, fuel oil and ship's draughts.

12.8.2 In addition, it is recommended that an interface with the onboard loading computer, connecting to the installed sensors detailed in 12.8.1, is to be provided to check the ship's condition during loading and unloading.

Part 5, Chapter 13

Ship Piping Systems

Effective date 1 July 2011

■ *Section 2* Construction and installation

2.5 Ship-side valves and fittings (other than those on scuppers and sanitary discharges)

2.5.11 For sea connections for ships having notation for ice navigation, *see* ~~Part 8~~ Pt 8, Ch 2,3.3, Pt 8, Ch 2,3.5 and Pt 8, Ch 2,11.21.

Part 8, Chapter 2

Ice Operations – Ice Class

Effective date 1 July 2011

■ *Section 1* Strengthening requirements for navigation in ice – Application of requirements

1.6 Loading manual

1.6.1 Sufficient information is to be supplied to the Master of every ship to enable him to arrange loading and ballasting in such a way as to avoid the creation of unacceptable stresses in the ship's structure. The following information is to be included in the vessel's loading manual:

(a) Upper and lower ice waterline.
(b) Propeller immersion.
(c) Indication of whether the vessel is strengthened for icebreaker towing.

■ *Section 2* General hull requirements for navigation in ice – All Ice Classes

2.1 General

2.1.2 The ballast capacity of the ship is to be sufficient to give adequate propeller immersion in all ice navigating conditions without trimming the ship in such a manner that the actual waterline at the bow is below the lower ice ~~light~~ waterline.

2.3 Rudder and steering arrangements

2.3.1 Rudder stoppers working on the rudder blade or rudder head are to be fitted.

■ *Section 3* General machinery requirements for navigation in ice – All Ice Classes

3.5 Main propulsion and essential auxiliary engines

3.5.1 Sea inlets for the cooling water system are to be provided with arrangements to maintain ice free cooling water arrangements as given by IMO *Guidance on Design and Construction of Sea Inlets under Slush Ice Conditions MSC/Circ.504* or by the *Finnish Swedish Ice Class Rules*. Alternative arrangements will be considered, such as by circulating engine cooling water via designated tanks where heat balance calculations have demonstrated that the engines are capable of operating at their maximum continuous rating.

3.5.2 For electric propulsion systems, the total engine output for propulsion provided by generator sets/central generation system is to be based on the calculation with one set out of action, *see* Pt 6, Ch 2,15.

■ *Section 6*
Hull requirements for first-year ice conditions – Ice Classes 1AS FS, 1A FS, 1B FS, 1C FS and 1D

6.6 Rudder and steering arrangements

6.6.1 Rudder scantlings, posts, rudder horns, solepieces, rudder stocks, steering engine and pintles are to be dimensioned in accordance with Pt 3, Ch 6 and 13 as appropriate. The speed used in the calculations is to be the maximum service speed or that given in Table 2.6.3, whichever is the greater. When used in association with the speed given in Table 2.6.3, ~~the hull form factor and~~ the rudder profile coefficients are to be taken as ~~1,0~~ 1,1.

6.6.8 Relief valves for hydraulic pressure are to be effective, *see* Pt 5, Ch 19,3.3. The components of the rudder steering gear are to be able to withstand the yield torque of the rudder stock, *see* Pt 5, Ch 19,3.2.2. ~~Rudder stoppers working on the rudder blade or rudder head are to be fitted.~~

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Ships.

Part 3, Chapter 14

4.1.2	*Reference* 8.1.8 *now reads* 8.1.9
5.1.5	*Reference* 8.1.9 *now reads* 8.1.10
9.2.5	*Reference* 8.1.9 *now reads* 8.1.10

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